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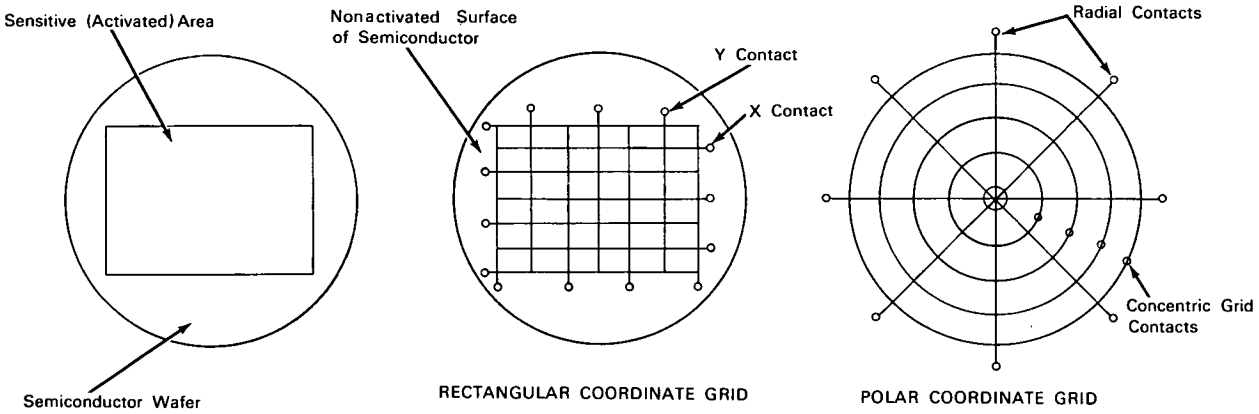
NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the space program.

Radiation-Detector Optical-Imaging Device Is of Simplified Construction



The problem: Designing a simplified radiation or electromagnetic particle detector that represents an optical image by sets of electrical signals. Detectors that are conventionally used for this purpose consist of semiconductor mosaic elements on a single substrate which is placed at the focal plane of the radiation. The conventional detectors require a relatively large number of mosaic elements to obtain accurate readings and are of generally complex construction.

The solution: A radiation detector which employs a continuous semiconductor surface with an electrical grid structure on the nonactivated side as the sensor element. The image pattern is identified by determining the relative times necessary for the charge carriers to arrive at the electrode locations formed by the grid.

How it's done: The activated continuous front surface of the detector consists of either the diffused or surface barrier type of semiconducting material. The grid structure on the nonactivated side of the detector may be either in the form of a rectangular coordinate system or a polar coordinate system. The individual elements of the grids are insulated from one another.

When the detector with the rectangular coordinate grid is exposed to low-intensity radiation fields or point sources, the distance between the parallel grid lines can be substantial, since the charge carriers drift from the activated spot to the neighboring contacts. The exact position of the radiating source can be determined by measuring the time intervals for the charge carriers to arrive at the two orthogonal sets of parallel electrodes. It has been calculated that with a 0.5 x 0.5-inch unit using 20 grid channels (x and y coordinates) and 20 amplifiers, a position accuracy of 2% can be achieved. (This accuracy compares favorably with that attainable using the more complex mosaic detectors.) Although the grid structure of the device has to be denser for high-intensity extended images, requiring a readout system which is comparable in complexity with that of the mosaic detector, the grid device offers the advantage of simpler construction.

(continued overleaf)

For tracking purposes, a polar coordinate grid would be preferable. The pattern would be similar to the equipotentials and field lines about a charged point source, with the field lines (radial lines on the grid) indicating the direction, and the equipotentials (concentric circles on grid) indicating the magnitude of the required correction.

Notes:

1. The detector can be constructed of any semiconductor material having suitable bandgaps facilitating pair production by an incident photon in the infrared, visible, ultraviolet, X-ray, and gamma-ray bands. The photon energy content is not a limiting factor in the use of the device.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B64-10299

Patent status: NASA encourages the immediate commercial use of this invention. Inquires about obtaining rights for its commercial use may be made to NASA Headquarters, Washington, D.C., 20546.

Source: Westinghouse Electric Corp. under contract to Goddard Space Flight Center (GSFC-251)